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Journal of the Society of Arts.

FRIDAY, JULY 18, 1862.

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INTERNATIONAL EXHIBITION OF 1862.

GUARANTEE.

The Council beg to announce that the Guarantee Deed is still lying at the Society's House for signature, and they will be much obliged if those gentlemen who have given in their names as Guarantors, as well as others interested in the Exhibition, will make it convenient to call there and attach their signatures to the Document. Signatures for sums amounting in the aggregate of £452,100, have been attached to the Deed.

SEASON TICKETS.

Season Tickets may be obtained at the Society's House, on application to Mr. S. T. Davenport, Financial Officer. The prices of the tickets are as follows:—£2 10s., admitting to the International Exhibition and the Gardens of the Royal Horticultural Society every day during the remainder of the season; £1 10s., admitting to the Exhibition only, every day; and 10s., admitting to the Exhibition on shilling days only.

CONVERSAZIONE.

The third Conversazione of the present season will take place at the South Kensington Museum on the 8th October.

NOTICE TO INSTITUTIONS.

A limited number of copies of a work entitled "The Iliad of Homer, faithfully translated into un-rhymed English Metre," by Francis W. Newman, Professor of Latin, University College, London, has been kindly presented by the author to the Council of the Society of Arts, for distribution amongst such Institutions in union with the Society as may desire to add this work to their Libraries.

Any Institution desiring to have a copy, should apply to the Secretary of the Society of Arts.

ON CONSTRUCTING AND MANŒUVRING SCREW STEAMERS, FOR WAR AND OTHER PURPOSES, AND THE APPLICATION OF A SCREW PROPELLER TO PREVENT FOULING.

By Commander T. E. Symonds, R.N.

As it is well known and admitted that there are many imperfections in the present method of fitting the screw, and in manœuvring and steering screw steamers, more especially those for war purposes, it is surprising that these subjects have not received more notice. It is true that a casual remark has been made as to the necessity for "protecting the screw," and improving the steering qualities, but, as a rule, discussion has been almost exclusively confined to the respective merits of "armour plates" and "guns," as though they were the only two things needful.

All seamen will admit that the objects I have named are not second in importance even to those two great questions; for of what comparative use is a ram or an armour-clad ship without the power of manœuvring rapidly, either to give a blow effectively or avoid that of an antagonist? and nothing more pitiable can be imagined than one of those leviathans shorn of its motive power, a helpless log on the ocean, at the mercy of the smaller vessels, her screw or rudder disabled, perhaps, by the first broad-side of an opponent half her size, or by the wreck of some mast she may have shot away in chase; for, be it remembered, a screw is as likely, or, perhaps, more likely, to be fouled by other ships' rigging and wreck than her own; and, if we are to judge from past accounts and delineations of naval actions, there must be plenty of this floating about at such times.

Although we have the highest authority for it, and common-sense dictates the necessity for rapidity and precision in manœuvring, what advance have we made in that direction to meet the requirements of the increased proportions of our ships? We find the reply in the published statements of their steering qualities. Reflect for an instant on the time and space it would occupy to turn such a ship as the *Warrior*, as now equipped, when at slow speed, and what incalculable damage might be done to her by one or more smaller shot-proof ships capable of turning twice to her once, which, having this advantage in turning, might always avoid her blow. An eminent engineer, on a very recent occasion, remarked that "it was one thing firing at a target and another at a ship constantly moving; and, therefore, as often offering an inclined plane to the shot as a vertical one. Ships," he said, "would not always accommodate you by placing themselves at right angles." Nothing can be more to the point; and, I add, no man would so "accommodate" his opponent if his ship were under perfect control, but would take the advantage manœuvring power gave him, and place her at an inclined angle with his antagonist, either to receive his fire or avoid the blow.

Now, although I admit that some of our screw steamers do manœuvre very fairly under favourable circumstances, there is not one of great length that could be moved with certainty, or anything approaching it, especially at slow speed—and it is at slow speed, I apprehend, that an action would be fought, at least a general one. It is one thing to describe a circle in a fair way and another to turn a ship short round in action. I contend that a perfect fighting ship, no matter whether armour-clad or otherwise, should have the power of turning in her own length, or nearly so, and that the steering power should be as perfect going astern as going ahead; that the propelling power, be it what it may, should be out of danger from shot or ram; and that she should be of such a draught of water as to enable her to go into any of our own harbours or docks without delay, or to stand fearlessly into an enemy's port, and occupy a position that would enable her to use her guns effectively, some means being adopted whereby the rolling would be reduced materially, a rifled or any other gun being comparatively of little use unless you have a steady battery to fire it from. The disadvantage of a heavy draught of water was constantly felt by our inshore squadrons during the old war, and has been more recently made manifest during the operations in China. With such examples before us need we hesitate to reduce it?

I am strongly of opinion that in ships, as in other machines, special tools are required for special work, if it is to be done perfectly. We must, therefore, make up our minds to throw overboard old notions, and adopt such as will meet altered circumstances, and not attempt to cram into a ship intended for operations inshore the same amount of stores and gear we should put into one intended for cruizing purposes, or expect to obtain any great results under canvas from ships required to steam at high velocity. It is very clear that some point must be conceded to obtain a special result, and I take it most are now of opinion that any attempt to effect a combination of qualities in ships of the present type will be futile. I believe that masts and sails are necessary to all classes, but only as an auxiliary in case of a breakdown, and to ease the "rolling motion;" they may be adopted without hesitation when the fouling of the screw is obviated, as I am confident it is in the form of propeller described in this paper. That keeping masts aloft eases the rolling motion is well known to practical men and those who have seen a dismasted ship in a sea way. It is obvious that no vessel without masts can roll as easily as with them (on the principle of the metronome), especially if they have fore and aft sails set with their sheets hauled flat aft, which will reduce the motion even in a calm, and is an expedient often resorted to. I therefore much doubt if ships without masts, as is contemplated, will be as efficient for general purposes as is expected, and their absence will be found very inconvenient in hoisting in and out heavy weights, fishing the anchor, &c.

At this point I consider it right to observe that Mr. Roberts was, so far as I can ascertain, the first to recognise the necessity for giving greater longitudinal strength to iron ships, and to promulgate this doctrine in his patent in 1852 (and on many public occasions), in which he compares a ship to a "beam," and that as in a beam (which increases in strength as the square of its depth, or nearly so), it was desirable to increase the sectional area of the iron in the upper part of the hull, and thus secure the utmost strength due to the whole depth of the ship's side from gunwale to bilge.

This conclusion was arrived at on noticing the weakness exhibited by iron ships of great length building at that period, the iron sides of which terminated at the deck, the top side being composed of wood of very light scantling, thus losing several feet of depth, and consequently a large proportion of strength on the upper side of the ship or beam.

Recognising the applicability of the cellular girder system to these iron ships, he next sought a mode of arranging it, by which the greatest strength could be obtained where it was most required, viz., at the top and bottom, without a corresponding increase of weight or interfering with existing arrangements.

Instead, therefore, of introducing girders under the deck, and consequently some six feet from the top of the ship or beam, as has been subsequently recommended by other authorities, he proposed to make his girders subservient to the requirements of his ship, forming them out of the cabins, saloons, coal-bunkers, and keels, as shown in the wood cuts (page 569); he likewise proposed to make the decks of iron. Thus the cabins on either side form a continuous cellular girder fore and aft the ship, the vertical parts being formed of the side of the ship and the face of the cabins, the top and bottom being composed of the iron main deck and a strong covering plate which runs fore and aft, and is connected with the upper deck or platform, the cells being formed by the divisions or bulkheads of the cabins. By this arrangement it will be seen that there would be a very great increase of longitudinal strength in the right place beyond that of a girder under the deck. Had the *Victoria* troop-ship been fitted with these girders, her bulwarks might not have been stove in on her late disastrous voyage.

Instead of making the "deck saloons" of wood or of iron in broken lengths, he proposes to make them of iron, forming a continuous girder, nearly from stem to stern, connected with the poop and forecastle deck; this would in itself be sufficient for all practical purposes; the sides of the saloon could be made like those of the cabins, or of a "lattice girder," with advantage, and thus admit of doors, windows, &c., being introduced without weakening the structure. This latter plan has been adopted (the lattice-bar excepted) in many light-draught steamers, but has not hitherto been applied to large steamships, although there are many instances on record, and some of no ancient date, where their presence would have been very serviceable.

Having thus disposed of the upper side of the ship (or beam), it became necessary to consider how the lower side could be formed so as to resist an amount of compression more than equivalent to the tensile strength of the upper (as wrought iron does not resist compression as well as it does tension). For this purpose, in addition to the cellular bottom, C (Figures 3 and 6, page 569), continued the whole length of the ship (and not merely in parts, as previous to his invention was done in some instances), Mr. Roberts applies two cellular keels, D D, of any required depth, one under each bilge, extending nearly the whole length of the floor; these keels, as represented in the wood cuts, are "cellular girders," which will not only give the required strength, but effectually defend the bottom plates on taking the ground, especially if fitted with timber false keels. If considered necessary, the bottom between these keels and on either side of the bilge might be lined with planking, and thus overcome the objection some entertain to iron bottoms in the event of a ship striking on rocky ground.

These keels will materially reduce rolling, and give general stability and strength to the whole fabric, especially in a longitudinal direction, making it more capable of resisting the shock produced by the ram manœuvre. They are, in fact, two huge back-bones to secure the ribs to, instead of one solid keel of plated iron, which, as is well known, is in every way weaker than one in a cellular form. Being parallel to the plane of the ship, they do not interfere with either steerage or speed, as has been proved in Mr. Tovell's ship. These cellular keels, in connection with the cellular bottom, may be adapted either for surface or internal condensation, as suggested in Mr. Roberts' specification. It will be seen, by referring to the drawing of the mid-section, Fig. 6, that the ship is divided longitudinally into three parts by iron bulkheads, which extend nearly the whole length, connecting the upper deck with the bottom, the longitudinal compartment thus formed being sub-divided by the athwartship water-tight bulkheads, and by the divisions of the cabins and coal bunkers.

I imagine that any seaman will at once perceive with what facility a ship fitted with such keels may be grounded on a favourable place, and her bottom repaired or cleaned (should no docks exist), the keels being in fact a gridiron, which may be made even more complete by slinging logs of timber under them. As the ship will remain in an upright position on these broad surfaces, no shores will be required, which, as in the case of the *Great Eastern*, might penetrate the bottom; a few spars over the side being sufficient to steady her. The risk of docking heavy ships would also be greatly reduced, the weight being distributed over a large area under each bilge, and the operation materially expedited. In engaging forts, what an advantage it would be to have a ship thus capable of grounding without danger, and fighting her guns with nearly the same facility as though afloat. It would certainly give confidence in approaching fortifications, or covering the landing of troops, and enable them to engage so as to do their work effectually at close quarters, instead of playing at long balls. Merchant vessels in taking the ground would be free from the risk of falling over, and thereby damaging their cargoes.

I contend that a light-draught ship fitted with these keels would, from the resistance they offer, have as good or better weatherly qualities than one of deeper draught without them. They are, in fact, to a ship what the two large logs are in the Pernambuco catamaran, than which there is no more weatherly craft afloat: these catamarans never roll. It is curious and instructive to remark how nearly the intuitive genius of the savage thus approaches, or, perhaps, more properly speaking, has anticipated, the deductions of science.

Light-draught gunboats and mortar vessels might readily be sent over sea without risk, deep temporary keels being added to those already in existence, which might be removed at pleasure.

Although I believe no one can suppose for a moment that any structure would have entirely withstood the tremendous sea which broke upon the *Royal Charter*, I question whether such a method of strengthening as I have described would not have held her together long enough to have afforded some chance of escape for many who found a watery grave on that fearful night. At all events, it is worth consideration, for how many tens of thousands are there who have to incur similar risks in the future.

That some additional strength on the upper part of our iron ships is required is, I believe, admitted by many, and was recently strongly advocated at the Institution of Civil Engineers; if not apparent now in our war ships, it is likely to make itself visible if they are subjected to any severe strains either by grounding, being in heavy weather, or being used as rams.

To obtain the greatest amount of capacity consistent with strength and required speed, I advocate a mid section of elliptical form, which is maintained throughout full one-half of the length of a uniform depth (being on an even keel); the bow lines being composed of easy curves on a principle by which the best form for entering the water I have yet seen is obtained; these lines are of such a character as to avoid any considerable bending in laying on the plates, which is a process attended with great trouble and expense.

This flat elliptical floor is continued to the fore foot; thus the fore-section is made self-supporting (the heavy part of the sharp floor, as in other ships, being dispensed with); it is consequently more buoyant, and, combined with the long floor, will reduce the tendency to pitch, and will "lift" in going against a head sea. The after section is composed of convex curves sufficiently fine to deliver the water freely, but not so lean as to diminish the necessary support in that quarter, the absence of which induces a sending to one side or dropping quarterwise, which my observation teaches me is one of the causes of rolling in ships of the present build, which, having the screw in the centre, require, it is supposed, a finer and longer run for the water to close upon it. A lean after-section also produces deeper immersion aft when at high speed (or squatting as it is sometimes called), which retards considerably. This form, combined with the cellular keels before referred to, I consider best calculated to produce a steadier platform than has been obtained hitherto, and by a proper adjustment of weights will reduce rolling to a minimum; without it guns of precision are of little avail, and you may as well attempt to fire a rifle at long range from a swing as a rifled cannon from a ship rolling through an arc of 30°.

It has been well proved that increased bulk and draught has not decreased rolling as was anticipated, nor have the "bilge pieces" had much effect (except to interfere with the steerage); is it not, therefore, time to try some other means of accomplishing this object?

It may appear at first sight that the section we propose is favourable to rolling; but it is the reverse when ballasted, and provided with two keels, as has been proved in Mr. Tovell's circular section, and as may be seen any day by experiment with a barrel or cylinder, which rolls more than any other form when empty, but when ballasted and fitted with a keel, less, and is, moreover, easier in its motion from the fact of the same section being always immersed. It is for experiment to prove which is the best for speed, the circle or ellipse; we prefer the latter, and especially as it enables us to keep our engines lower.

My experience among the beautiful slavers on the coast of Africa and the best models in our yachts, more particularly those of Mr. Weld, convinces me that a light-draught, long-floored vessel is, beyond all doubt, the fastest before the wind. So far was that opinion received among the owners of slavers in the year 1840, that vessels were constructed purposely, with orders never to haul on a wind if chased. As in sailing vessels with the sails acting in a line with the keel, so is it, I believe, in screw steamers; and for this, added to other palpable reasons, do I advocate as light a draught as possible in all war steamships, believing that it will be found in practice, that, so long as the form is good, an increased width at the water-line with decreased depth (provided the immersed area of mid section is the same) will be more readily propelled than the same area at a deeper draught with less beam. It is clear that the light-draught body is displacing water of less density, and will not throw up that tremendous wave which is observable in most deep ships at high speeds. Light-draught ships are proverbially good sea boats; the old Danish vessels, for instance, our fathers remember, and often quote, as being handy and weatherly.

A light-draught ship, whether for war or mercantile purposes, must possess decided advantages over those of heavy draught on numerous occasions, and especially when intended to operate inshore, when they may there evade them by crossing shoals or bars, and take shelter under batteries (or attack them). Merchant vessels, also, trading to the northern and other ports, having tidal or bar harbours and rivers to contend with, are liable to detention and loss by waiting for water—Amsterdam and Rotterdam traders, for example. A light-draught ship on an even keel, fitted as described, would possess immense advantage over a long-heeled vessel taking the Brill Bar, where ships often thump for hours and damage themselves aft, as the shock would be distributed over the entire length of the two cellular keels, the draught being the same fore and aft.

A reduction of even two or three feet would obviate much of the delay now often incurred in going into Portsmouth and other harbours, and reduce the risk. It would also make present dock and harbour accommodation available without incurring the enormous expense consequent on alterations, which, it appears, are necessary ere the present class of large war steamers can be accommodated readily. At all events, a reduction in draught would set at rest the many questions that have arisen as to the ultimate value, or otherwise, of Portsmouth as a port for such a class of ships, and prevent the necessity of dredging a hole for a deep-draught ship to lie in, as in the case of the *Resistance* at Chatham.

It is, however, obvious that the draught cannot be considered reduced under the present system of propulsion with one screw, so long as great speed is required, for to retain great speed it is necessary to have a screw of great diameter, which entails great draught; and I much question, even with the present draught, if the screw is sufficiently immersed in many ships to produce the best results. In some, having a smaller screw well immersed, a greater portion of duty has been observed. However, be this as it may, if one screw cannot do the work at a reduced draught of water, why not use two? I believe the principal objections to two screws are, that the chances of fouling are multiplied; that the present form of after-section, with the dead wood intervening, would not admit of sufficient diameter, and offers a great obstruction to propulsion and steerage; and, that the speed at which it would be necessary to drive screws of finer pitch would be too high. Good results have, nevertheless, been obtained in many instances, and especially in one case I am acquainted with. The vessel in question is about 90ft. long, 12ft. wide, 3ft. 3in. draught; having two screws (3-bladed), 3ft. diameter, driven by two single-cylinder engines. She often attained a speed of eleven knots, and proved herself a capital tug, performing in a manner that quite baffles any calculation that is usually applied to ascertain the power of a single-screw steamer. This vessel was steered by her screws alone, either going ahead or astern, in the most perfect manner, turning easily and quickly in her own length. Steamers with two screws are largely and successfully employed as tugs in America, and some of the best French gunboats are also fitted with them. Why should they not be here? I am aware that bad results have been obtained in several vessels fitted with two screws, but failure is as often caused by a wrong application of a principle as by any defect in it. In the form and arrangement I advocate, the obstruction due to the present form of vessel being entirely removed, the conditions are altered.

Encouraged by results that have already been attained by steamers with two screws, I have less hesitation in advocating the use of them on this occasion, especially as by the peculiar method in which we propose to apply them, most of the objections referred to are obviated, the screws we submit being of a form that will entirely prevent fouling; the obstruction of the "dead wood," after stern-post, and rudder being removed, we are at liberty to increase the diameter, and still have free space for them to work in, the water having undisturbed access from every direction. The rudders are so placed as to improve the steering power without interfering with the screws, rudders and screws being constantly submerged at such a depth as to defend them from shot, prevent their being lifted out of the water, or injured by the ram manœuvre.

Previously to describing this arrangement, I will consider the inconvenience arising from the present method of fitting the propeller, which is well known to be constantly liable to foul, and, therefore, specially inapplicable to war purposes, in which delay is defeat.

The numerous plans that have been suggested as a remedy prove the importance of this question. "Guard bars," "knives on the boss," and a variety of other expedients equally inefficient (which only aggravate the evil), have been laid aside, and still accidents, of a more or less fatal character, are constantly occurring. It was only the other day that one man's life was sacrificed, and that of many others in jeopardy, by the hawser attached to the *Great Eastern* fouling the screw, and in an instant capsizing and smashing a large man-of-war's boat, and precipitating her crew into a tide-race, at Milford Haven.

The frequent accidents and detentions from the same cause are now patent to all; I shall, therefore, not recapitulate them, but proceed to other objections of an equally important character.

The screw is in most instances so near the surface that it must catch every floating object within its influence; and being lifted out of the water by the slightest pitching motion, and often bared by the undulation of the wave, it loses a large proportion of its effect; and if not fitted with a good governor, the engines are liable to be strained by "racing," which may be attended with serious results in such engines as are now fitted to our large class steamers, and often causes a fracture of the blade on re-entering the water after acquiring a high velocity. Being thus near the surface, the screw is likewise liable to injury from shot, and I take it that it would be the target for the first broadside, for once crippled in that quarter, the ship would be at the mercy of her opponent. Again, being within a few inches of the bottom, it is liable to be broken by striking a rock or any hard substance, as in the case of the "*Defence*," at Spithead, the other day, on her trial trip.

It is fair to suppose that in going up rivers or entering the narrow seas or channels of an enemy, every means will be resorted to that ingenuity can suggest to cripple an opponent. Among others I know of no more certain means of fouling a screw of any size than mooring trains of nets, with their 4-inch warp attached to them, some feet below the surface, at various distances. They would as certainly protect the approach to a harbour from a screw steamer as anything that could be devised. Some of the skippers of our screw steamers trading coastwise are, I suspect, well aware of this fact.

Apart from this tendency to foul, both screw and rudder are entirely dependent on the after stern-post, which is liable to be bent or broken by a sea striking the exposed part of the rudder, the rudder-head being also liable to damage from the same cause, as in the "*Great Eastern*." This may arise from a defective weld or wrong proportion in that long, unsupported bar of iron which is so costly and difficult to forge, and which, with its appurtenances, adds materially to the weight at the extremity, where all should be as light as possible. It is also liable to be bent by a blow from heavy shot or ram, or by striking the ground aft, which is by no means an improbability in a long-heeled ship, drawing 27 feet or 28 feet of water. In either case the rudder and screw-lifting frame might be jammed, the screw-shaft thrown out of centre, and the ship crippled either for sailing or steaming. The after stern-post displaces a large column of water, and together with the vacuum caused by the stern-post passing through the water, offers a considerable obstruction to speed, while the opening for the screw allows the water which would otherwise impinge on the rudder to pass through and diminish the steering power. This is sometimes felt to a considerable extent when under canvas. The after bearing of the screw being open at the upper side, is liable to catch anything falling upon it, and thus jam the shaft, as occurred not long since to one of our war steamers.

The method we propose for remedying these evils is first by using a propeller, F (Fig. 3), which by its form alone is calculated to reject or throw off all impediments, and if striking a hard surface will not receive any serious injury. This propeller may be readily applied to ships of the present type, with or without an after bearing; we prefer the latter. In this case the chances of fouling would be materially reduced, but cannot be prevented to the same extent as in a ship constructed or altered to suit it.

The vanes or blades are of wrought iron or steel secured to spiral flanges on the boss, the flanges being covered by a cycloidal casing of wrought iron; the root of the blades being long, and therefore well supported, admits of their being made thinner than those of the ordinary shape in cast metal; being thinner, they displace less water, and consequently absorb less power in turning; being of wrought iron, they are far less liable to injury, and can be readily replaced or repaired when damaged. They may be estimated at about half the weight, and one-third or one-fourth the cost of those made of gun-metal of the same diameter.

Cast-iron or cast-metal blades of this form would be far less liable to injury than those of the ordinary shape, as they would not strike a direct but a glancing blow. These blades are tapered on both the leading and after edges, and when in rotation, whether turning ahead or astern, may be said to form a cone that will throw off any passing wreck chain or cordage without fouling or injury; a coil of rope falling upon this screw would be instantly thrown off. This form of blade will also insure a more constant and equable action on the water under all circumstances, and thereby reduce vibration. It may be applied to vessels of very light draught for river purposes half immersed, as in many American river and lake steamers.

The method of attaching it to the shaft enables it to be readily shipped and unshipped, and being comparatively light, the after bearing is dispensed with, part of the after length of the screw shaft into which the short shaft of the propeller is shipped being of increased diameter, so as to give a sufficient bearing to prevent the weight of the screw wearing unduly, and to admit of being bored out to receive the short shaft attached to the propeller, which is secured by a key, gib, and cotters; by this means the screw and short shaft may be removed without disturbing the main shaft or admitting water into the ship.

It will be seen by the woodcuts that the part known as the "dead wood" in timber-built ships is dispensed with, and with it all the cumbrous and costly paraphernalia of stern-posts, screw-lifting frame, and, in fact, every forging of any consequence, thereby reducing the weight of the after extremity, and the cost of the ship. There being no aperture for the screw, the section will be stronger and lighter.

As before stated, I advocate two screws of the form and character described (any other form may, however, be applied if preferred), having three or four blades; these are fitted to cylindrical trunks, G, Fig. 3, under either quarter, which connect the keels with the counter of the ship; these trunks are the same diameter as the boss of the screws, against which they fit closely, so as to prevent anything getting between them, the rudders, H, being attached to the after extremity of the keels, but before and lower than the screws, so that both screws and rudders are quite clear of each other, and are thus capable of performing their respective functions without hindrance, both being immersed at such a depth as to place them entirely out of reach of shot or ram, and prevent their being lifted out of water. Should it be found that these rudders are too close to the screws and impede their action, they may be placed farther forward, without detriment. It will be seen that by this method of fitting the screws, the water being already displaced by the ship and trunks, it comes direct to the screw-blade and closes by its own gravity on the cycloidal boss, leaving an appreciable vacuum, whereas in the ordinary mode the boss not only displaces a large volume of water, but leaves a considerable vacuum in its wake, which will absorb power, retard speed, and, I am inclined to believe, cause vibration.

Being right and left screws, they turn in opposite directions, and, therefore, correct that deviation from a right line, either would produce separately (as is well known); thus, the helm is not required to counteract that effect; there is, consequently, less obstruction to the ship's way. By reversing either screw the ship may be turned rapidly by the screws alone to starboard or port in her own length (as with two sculls in a boat, one backing and the other pulling), and may be steered, going ahead or astern, by these screws, without any assistance from the helm, in the most accurate manner. This I have seen accomplished so perfectly, that there can be no doubt of success if they are properly fitted. The absence of the after stern-post and dead wood, combined with the reduced immersion, will materially facilitate manœuvring, there being considerably less area of resistance; and under any circumstances, whether stationary, at slow or at quick speed, a vessel thus equipped will answer her " screw " instantly, and not only take up, but retain, her position, no matter what the circumstances.

These screws, having their centres much lower than a single screw of the same calculated power, will work uniformly in water of greater density, be far less liable to accident, and, being constantly immersed, will, it is believed, give a result beyond that of a single screw of the usual character. Their size, and the speed at which they are driven, will, of course, be determined by the required speed of the ship. Moreover, both screws and rudders are in a more favourable position for working, being not only constantly immersed, but well removed from the centre of the wake where the water is broken, and there is an eddy or swirl caused by the water closing in from both sides the dead wood, which increases with increased speed.

The rudders are geared together, and worked by steam or by a wheel on deck, or in the after part of the engine-room, so that in action the engineers and helmsmen receive orders simultaneously, helm and screws acting together on the instant, helmsmen and steering apparatus being out of reach of shot. I submit that such a combined power of steering would give great advantage to a ship in action, or in narrow seas, over one with one screw, " which would go " against the helm, whichever way her bow " happened to take," whether from the force of wind or current.

In this method of fitting the screws no provision is made for lifting them, it being considered unnecessary, for, in the first place, it is not at all probable that large under-rigged ships would be allowed to depend on sails alone, particularly on special service; and if making a passage the screws could be disconnected or driven by the donkey engines at a speed to overcome friction. I question much if they would make any material difference if not driven; at all events, not much in excess of the resistance now offered by the after stern-post and screw aperture, which must retard very considerably. In this opinion I am supported by the reports of many captains of screw steamers. In smaller vessels and gunboats these screws might (as we propose to fit them) be readily unshipped and hoisted in over a bill-board on each quarter; the passage could be thus made as a sailing vessel, and the screws easily re-shipped when necessary without docking.

As the utility of efficient gunboats of very light draught is now beyond all question, I consider this method of constructing them would be attended with many advantages, especially in ascending rivers, where they are constantly liable to ground, or defending our own coast; the keels, as before described, also giving sufficient strength and stability to make a sea voyage; but unless some very decided alteration takes place in the construction and arrangement of boiler, no considerable reduction can be made in the draught of our gun-boats, some of which have two sets of low-pressure boilers, one reaching nearly to the deck, for ordinary purposes, styled " working boilers," which, being exposed to shot, cannot and are not intended to be used in action. The other set, placed lower, but occupying greater fore and aft space, are called " fighting boilers." These, at their best, cannot generate more than sufficient steam to propel the vessel nine knots; whereas, if a suitable form of high-pressure boilers were used, fitted with a surface condenser, they would occupy even less space than the " fighting boilers," do the work more effectually, and leave the space and displacement now occupied by the working boilers for coal or any other purpose. The form of high-pressure boiler, and the method of connecting it with the uptake described hereafter, would be well adapted for this purpose. The engine would also be far lighter and more readily handled than those now in use, especially if fitted with wrought-iron framing.

That steam, at high pressure with surface condensation, must be eventually adopted in war steamers is so universally admitted by engineers, that any remarks I might offer would be superfluous, beyond the fact of Mr. Roberts having constantly urged the adoption of both in his patent, and on many public occasions.

The arrangement for the " uptake " of the furnaces, O, Fig. 3, allows one boiler to be cut off without interruption to the remainder; the cellular casing, around the funnel, will ventilate and lower the temperature of the boiler-room besides giving additional support and protection to the funnel. Instead of the stokers being between two long rows of furnaces, they stoke from opposite sides, which must necessarily improve their condition.

The coal bunkers, E, Figs. 3 and 4, on either side the boiler and engine-rooms, and athwart ships (as shown in the woodcuts), will add to the security of both, defending them from any shot that may either penetrate the armour plating or strike below it.

The plan of fitting the coal bunkers forms an important feature in the cellular system, and adds materially to the longitudinal strength, so specially requisite in light-draught ships, in which " the beam " is of decreased depth.

The coal bunkers in large ships may be filled expeditiously by means of small carriages running on a tramway, the cells being made to communicate with one another, so that the coals can be readily removed if required.

In this cellular arrangement much coal trimming will be dispensed with, as coal may be taken from any required cell of the bunker without the remainder shifting.

Although the advantages of this principle have been generally admitted, it has been only partially adopted in some instances, but never carried out in its integrity.

The surface condensers are in two sets; as proposed in the specification, they are constructed and arranged in a series of cylinders, either of which may be removed for cleaning or repair without impeding the action of the remainder.

I propose to have four masts, so disposed that the ship may be manœuvred without head-sails on a bowsprit, as I consider that appurtenance not only superfluous, but ill adapted for war purposes, especially if used as a ram.

As it is of the utmost importance that every contrivance should be resorted to that may reduce weight, economise space, and save labour, I advocate a more extended use of simple mechanical contrivances than has heretofore been the custom, and if the reduction in the crews that has been spoken of is carried out in consequence of decreased armament, "labour-saving machinery" must be adopted.

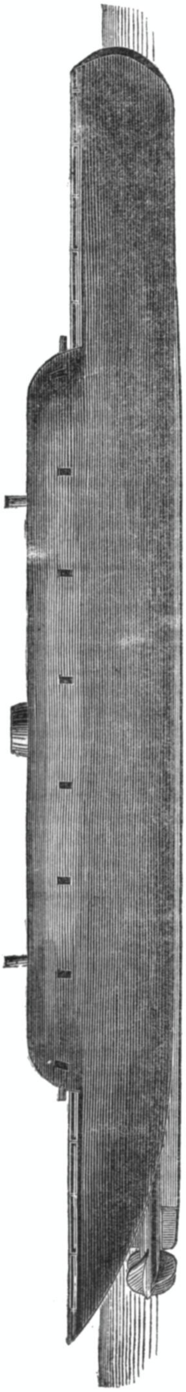

FIG. I.

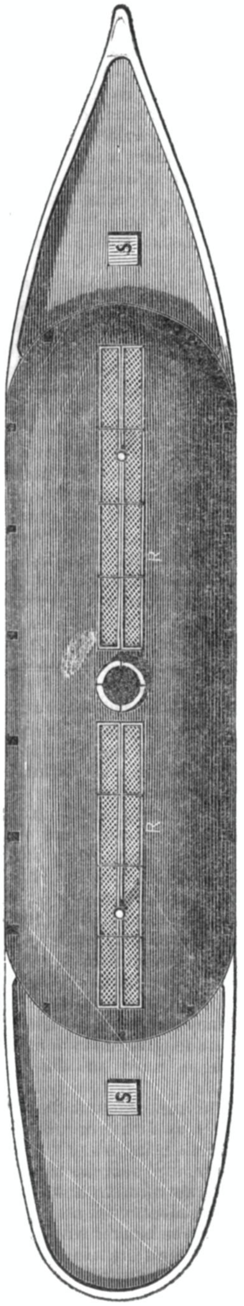

FIG 2.

The woodcuts represent plans and sections of a light-draught coast defence ship, of about 2,300 tons; length 240 feet, breadth 45 feet, draught 15 feet, mounting 14 guns, 8 feet 6 in. above the water.*

Fig. 1 is a general exterior view, showing a proposed method of protecting the guns by inclined armour-plated sides, rounded from the deck upwards, terminating in a rounded platform or deck; the top sides fore and aft being fitted to lower when bow or stern guns are used.

Fig. 2, deck plan, showing a method of giving ventilation and light, relieving the gun-deck from smoke by a strong iron grating, R, in which are hatchways for giving access to the deck, for boarding or repelling boarders.

S S are other hatchways, similarly fitted for ventilation and access to other parts of the ship.

Fig. 3, longitudinal section, showing internal arrangements.

T. Bread and dry provision room.

K. Engine room.

E. Athwart ship coal-bunkers.

N. High-pressure cylindrical boiler, with method of fitting the uptake to funnel, and the cellular casing round the funnel to give ventilation in the boiler room—same arrangement round masts to ventilate between decks. The funnel is telescopic; when run down projects only three feet above the deck in action, and is protected, the draught being given by the apparatus described, which also prevents smoke.

U. The magazines.

W. Windlass, described previously.

X. Form of stem for receiving the prow of ram, and method of strengthening the bows to resist the shock, being a series of short decks or breast hooks.

Fig. 4. Arrangement of longitudinal bulkheads, forming cellular girder, with the side applied as coal bunkers, water tanks, and other purposes.

Fig. 5. Stern view, showing propellers, and three stern chase guns, with gunwale lowered on starboard side.

Fig. 6. Section in engine room, showing proposed arrangement of engines, K; coal bunker, E; with cellular bottom and keels, C, D.

This vessel is intended for the defence of harbours, or to cross the Channel if required, being quite capable of taking the sea, and may be rigged either as a schooner or polacca. She is fitted to act as a ram, and, from the great longitudinal strength imparted by the peculiar mode of construction described, is, I conceive, specially adapted for that purpose; as also from the fact of the two screws giving her the power of *turning in her own length*, and, being steered by them, going ahead or astern without assistance from the rudders; in fact, under steam the rudders are unnecessary.

I propose to arm this vessel with 14 guns, two of which are to be of very heavy calibre, one forward and the other aft, being bow and stern chasers, firing in a line with the keel. The guns on either side may be fired in the same direction, or as broadside guns, by shifting them, there being spare ports for the purpose. Thus, three guns can be brought into action, whether chasing or retiring, and six on the broadside.

The cellular keel and bottom will allow sufficient water to be admitted to immerse the ship from a foot to eighteen inches; thus one foot of armour plating might be dispensed with, and a smaller mark displayed to the enemy.

This plan of defending the guns, in addition to the advantage of having a battery of three guns forward and aft, will reduce the weight of hull and armour plates.

Smaller vessels on this plan, drawing ten feet of water, and mounting four guns, might be very effectively employed in rivers, small harbours, and creeks, they being capable of grounding without injury, and when grounded, of being upright. Moreover, such a shield vessel, having the power of turning as described, would become "the turntable," and thus bringing the guns into action as required, would possess most of the advantages claimed for the cupola system without its defects.

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* This model was designed by us to meet conditions suggested by Rear-Admiral George Elliott, and submitted by him to the Admiralty and War Office, in June, 1861.

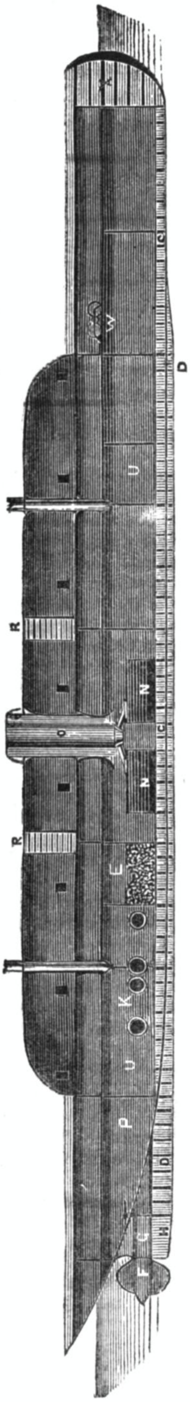


FIG. 3.

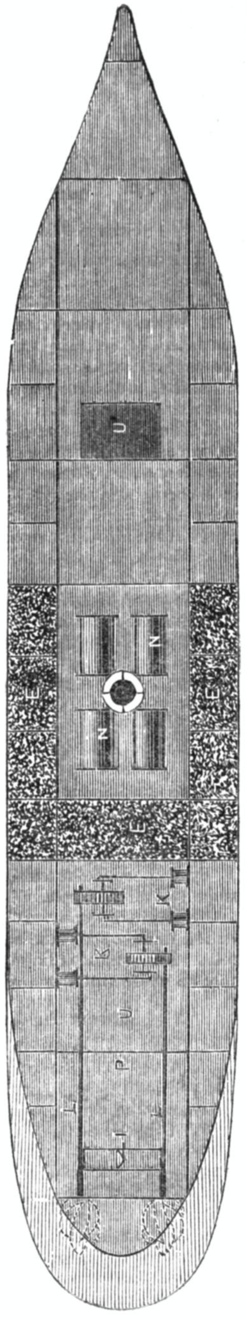


FIG. 4.

In conclusion, I beg to call attention to the fact that in all the arrangements I have described there is a *duplicate of every principal part*, so that in the event of one breaking down, the ship may never be totally disabled, except under very extraordinary circumstances. This will, I believe, be admitted by sailors (and it is to them more especially I address myself) to materially enhance the efficiency of a steamship of war of whatever description.

FIG. 5.

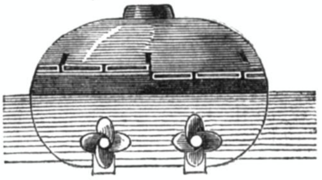
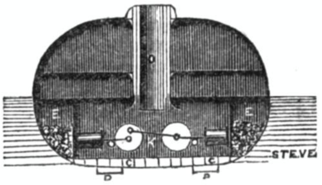


FIG. 6.



Models of these vessels may be seen at the Naval Department of the International Exhibition, Class 12, No. 2,715, and at 10, Adam-street, Adelphi.

EXAMINATION PAPERS, 1862.

The following are the Examination Papers set in the various subjects at the Society's Final Examinations, held in May last :—

(*Continued from page 560.*)

MENSURATION.

THREE HOURS ALLOWED.

1. Find the number of feet and inches in the rectangles, which are :—

(1.) 11 feet 7 inches by 7 feet 11 inches.
(2.) 11 feet 7¾ inches by 34 feet 11½ inches.
(3.) 50 feet 5 inches by 31 feet 2·4 inches.

2. The area of a rectangle is 83 feet 123 inches, and one of its sides is 14 feet 7 inches. Find the other side.

3. What will it cost to paper a room which is 18 feet 10 inches long, 15 feet 5 inches wide, and 11 feet 2 inches high, the paper being 27 inches wide, and 4½d. a yard?

4. How many standard rods of brickwork are there in a wall which is 36 feet 3 inches long, 6 feet 5 inches high, and 2½ bricks thick?

5. Prove experimentally that the square on the hypothenuse of a right-angled triangle is equal to the sum of the squares on the other two sides.

6. The diagonals of a diamond-shaped pane of glass are 3½ and 4 inches. How many will be required to glaze a window which is 2 feet 4 inches by 3 feet 6 inches?

7. A rectangular lawn of an acre in extent is surrounded by a gravel walk of uniform breadth, the sides of which are 4⅓ and 4 chains in length. Find the breadth of the walk.

8. A vessel contains 78 feet 1698 inches; its sides are in the ratio of 2 to 3, and its depth is 3 feet 7 inches. Find the lengths of the sides.

9. How many gallons will this vessel hold? Find the

cost of lining it with lead one-eighth of an inch thick, at 18s. per cwt.*

10. Find the depth of a cylindrical vessel which holds 50 gallons, the diameter being two feet.*

11. A circular ring contains 10 cubic inches; its whole surface, plane and curved, is 40 inches, and its section is a square. Find the diameter.

12. A spherical bullet an inch in diameter is shot clean through a board 4 inches thick. Find the quantity of wood carried away—

(1) When the bullet goes through in a direction at right-angles to the surface.
(2) When it goes through obliquely.

13. How many square feet of bark would come off a tree whose girth at the base is 4 feet, and at the top 1½ feet, and whose height is 35 feet, the tree tapering uniformly from bottom to top?

14. The slant side of a tumbler is 5 inches, the diameter of the top 4 inches, and of the bottom 3. Find the weight of the water which it will contain.*

15. A hemisphere and a cylinder have the same volume and the same diameter. Find the ratio of their surfaces.

16. Define a pyramid. Prove that the volume of a pyramid $= \frac{1}{3}$ base $\times$ perpendicular height.

TRIGONOMETRY.

THREE HOURS ALLOWED.

1. Find the unit when the equation, angle $= \frac{8}{\pi} \frac{arc}{rad.}$ is an expression for the angle. What is the meaning when the arc is a quadrant?

2. Trace the changes of sign and value of cos. A— sin. A, as A increases from zero to 2π. Find all the values of $\sin.^2 A = \frac{1}{2}$.

3. Given, sin. A. and cos. A: Find sin. 2A and cos. 2A, without using sin. (A + B) or cos. (A + B).

4. One side of a triangular field is 2000 feet, the bearings of the third angle from its corners are 60° and 45°; find the number of square yards in the field.

5. Find A from the equations—

(1.) $\text{Tan.}\left(\frac{\pi}{4} + A\right) = 3 \tan.\left(\frac{\pi}{4} - A\right)$

(2.) $\text{Tan } 2\text{ A} + \text{Cot. A} = 8 \text{ Cos.}^2 \text{ A}.$

6. Show that—

(1.) $\text{Tan } 3a - \text{Tan } 2a - \text{Tan } a = \text{Tan } 3a. \text{ Tan } 2a \text{ Tan } a.$

(2.) $\text{Sin.}(A - B) + \text{Sin.}(B - C) + \text{Sin}(C - A) + 4 \text{ Sin.}\frac{A - B}{2} \text{ Sin } \frac{B - C}{2} \text{ Sin. } \frac{C - A}{2} = 0.$

7. If A′, B′, C′ be the three exterior angles of the triangle ABC, and S be the semi-perimeter, then—

$$\frac{\text{Vers. A}'}{\text{Sin. A}} + \frac{\text{Vers. B}'}{\text{Sin. B.}} + \frac{\text{Vers. C}'}{\text{Sin. C.}} = \frac{S^2}{\text{Area.}}$$

8. A person, a feet from a tower on which is a spire, observes that the top of the tower is in a line with that of a hill. From a point na feet further from the tower, he finds that the spire subtends at his eye the same angle as before, and has its top in a line with that of the hill. If the height of the tower also $= na$, show that the hill's height is $\frac{n^2 a}{n^2 - 1}$

9. If A, B, C be the three angles of a triangle, then

$$\frac{\text{Sin. A} + \text{Sin. B} - \text{Sin. C}}{\text{Sin. A} + \text{Sin. B} + \text{Sin. C}} = \text{Tan. } \frac{A}{2} \text{ Tan. } \frac{B}{2}$$

10. Find the sum of n terms of the series—

$\text{Sin. } a. \text{ Sin. } 2a + \text{Sin. } 2a. \text{ Sin. } 3a + \text{Sin. } 3a. \text{ Sin. } 4a,$ &c.

11. In spherical trigonometry prove that—

$$\text{Tan. } \tfrac{1}{2}(a + b) : \text{Tan. } \tfrac{1}{2}(a - b) :: \text{Tan. } \tfrac{1}{2}(A + B) : \text{Tan. } \tfrac{1}{2}(A - B).$$

A and B being angles, and a, b, being the opposite arcs.

12. ABb, AcC, are two arcs of great circles meeting in A; BC, bc are two others. Find BC, when AB, Bb, Ac cC are given.

13. Prove in any spherical triangle that—

$$\text{Cos. } a = \text{Cos. } b, \text{ Cos. } c + \text{Sin. } b, \text{ Sin. } c, \text{ Cos. A.}$$

14. Deduce from this Cos. A, in case of a rectilinear, triangle.

CONIC SECTIONS.

THREE HOURS ALLOWED.

SECTION I.—GEOMETRICAL CONICS.

1. Define a tangent to a conic. If the tangent to a parabola at a point P meets the directrix in Z, prove that SZ is perpendicular to SP.

2. What is a diameter of a parabola? Show that all diameters of a parabola are parallel to each other, and that the tangent at the point where a diameter meets a parabola is parallel to the corresponding ordinates. In what sense is it a "limit" of them?

3. The radius of the circle of curvature of a parabola at its vertex is equal to twice the focal distance.

4. Define an ellipse. Show that it has two foci and two directrices; and that the sum of the distances of any point in its plane from the foci is greater or less than the major axis, according as the point is within or without the ellipse. What is the corresponding property of the parabola?

5. Prove that the major axis of an ellipse, the tangents at the extremities of a latus rectum, and the corresponding directrix, all pass through the same point.

6. P and D are the extremities of a pair of conjugate axes in an ellipse, of which C is the centre, and S and H are the foci. Show that $SP \times HP = CD^2$. If the ellipse is projected orthogonally into a circle, what do the projections of a pair of conjugate diameters become?

7. The asymptotes and one point of a hyperbola are given. Determine other points of the curve by a geometrical construction.

8. If the normal at any point P of a hyperbola meets the transverse axis in G, then SG : SP :: CS : CA.

9. Draw a tangent to a conic from a point without it; (1) by a direct construction; (2) by means of the projective properties of the circle.

10. Define a cone. If a cone is right, show that the section made by a plane parallel to a slant side is a parabola. If a cone is oblique, show that two circular section may be made through any point in its surface.

SECTION II.—ANALYTICAL CONICS.

11. Find the length of the perpendicular drawn from (x_1, y_1) on the line passing through the two points (x^2, y^2) and (x_3, y_3); and hereby determine the area of the triangle of which these three points are the vertices.

12. If the base of a triangle is given, and the difference of the squares of the sides is constant, prove that the locus of the vertex is a straight line perpendicular to the base.

13. Find the equation to a circle, when the origin is a point on the circumference. Hence prove that the angle in a semicircle is a right angle, and that the sum of the opposite angles of a quadrilateral figure inscribed in a circle is equal to two right angles.

14. Determine the equation to the tangent of an ellipse; and prove that the distance from the centre of the point of intersection of the tangent with the perpendicular on it from the focus is equal to the semi-major axis.

15. If (x_1, y_1) $(x,^2 y^2)$ are the extremities of two conjugate axes of an ellipse, prove that

$$\frac{x_1 x^2}{a^2} + \frac{y_1 y^2}{b^2} = 0.$$

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* A gallon contains 277·274 cubic inches.
A gallon of water weighs 10 pounds avoirdupoise.
Lead is 11·35 times as heavy as water.

16. Prove analytically the theorems contained in questions 1, 2, 5, 8, of the preceding section.

17. What relations exist among the co-efficients in the general equation of the second degree when it represents (1) two intersecting straight lines; (2) two parallel straight lines.

18. Examine and trace the lines represented by the following equations:—

$$(1)\ 4x + 3y - 12 = 0$$
$$(2)\ 3x^2 + 2xy + y^2 - 4x = 0$$
$$(3)\ 3x^2 - 4xy + a^2 = 0$$

(To be continued.)

Home Correspondence.

CONDENSED AIR FURNACES.

Sir,—The principle on which these furnaces are constructed is that of burning the fuel, whatever it may be, in a chamber artificially filled and supplied with air at a greater density than that of the ordinary atmosphere.

The heat obtained by combustion varies, so far as quantity is concerned, according to the weight of oxygen that has combined with the carbon or hydrogen in the fuel. The intensity of that heat increases in a high ratio with every increase in the rapidity with which that combination is effected. For example, in rarified air, such as exists at elevated levels, combustion is languid. At the top of high mountains even sulphur and alcohol give little heat, and at certain altitudes can scarcely be kept alight at all. On the other hand, the slight condensation of air produced by cold renders our common fires more intense, causing them, as we say, to "burn frosty."

We may be sure that this intensification does not cease at the atmospheric density represented by a pressure of 30 inches of mercury, but proceeds to a (theoretically) unlimited extent. Practically there is no difficulty in establishing an atmosphere artificially condensed to a pressure at least three or four times greater than that of our normal barometrical standard, and supplying, at that pressure, as much air as the furnaces, &c., employed may require for their consumption.

This effect I propose to accomplish by my new patent furnace. The mechanical apparatus required presents no serious difficulties, and would necessitate no very serious cost. The useful results that may be thus realised are twofold in character, namely, mechanical and chemical.

Chemically, as the air supplied to the burning fuel will contain, bulk for bulk, two, three, or four times the usual quantity of oxygen, the incandescent particles of carbon or hydrogen are so much the more easily enabled to find their proper dose of that element, and to enter into combination with it. The atoms of oxygen are at the same time pressed into closer contact with those of the fuel; and it is well known that all chemical action supervenes with rapidly increasing intensity as the combining elements are brought into nearer proximity. The space, moreover, within which the actual process of combustion is completed, that is, through which the vaporised particles of combustible matter have to travel before they meet with oxygen enough to burn them, is diminished; and the burning atoms being thus kept in closer companionship, the resultant product both of heat and light is enormously enhanced. As diffusion rapidly attenuates heat and light, so compression as rapidly intensifies both.

Mechanically, one great advantage will be obtained from the much smaller volume of air that must be passed through the furnace in order to ensure rapid combustion. In our blast furnaces several thousand cubic feet of air are often blown in per minute, and nearly equal volumes are carried through furnaces of another construction by the powerful draft produced by enormous chimney-stacks or the injection of steam. This current of air, while feeding an intense combustion, carries off a large per-centage of the heat evolved. By various ingenious contrivances much of this heat is afterwards arrested and utilised, but it is altogether lost at the point where it is chiefly required—that is to say, in the furnace itself.

A second advantage arises in this wise:—As the heat from the burning fuel is communicated to the body on which it has to act, not only (or chiefly) by actual contact, but by the intensely-heated air that has passed through the incandescent mass, the calorific effect will be increased by the presence, in a given bulk, of a large number of heat-producing atoms; and as the passage of this air may be rendered slower, these atoms can also be longer retained in contact with the body to be heated. Among other results of this action may be reckoned a considerable diminution in the surface area of steam-boilers, as measured by their evaporating powers.

In its application to steam-engine furnaces, the "condensed air system" would present the further advantage of producing high-pressure steam of 45 or 60 lbs. to the inch from thin boilers, worked with a loose valve, thus saving expense, and avoiding all risk of explosion.

In founding iron, steel, glass, &c., great compactness, strength, and homogeneity are obtained by creating, at enormous expense and trouble, a large "head" of fused material above the mould. The mechanical pressure exercised by an atmosphere of threefold density is in itself equivalent, in the case of iron, to a "head" of nearly 15 feet, and in that of glass of more than 40 feet of melted "metal" in perpendicular height.

Furnaces on the condensed-air principle may be applied to almost every purpose—for smelting ores, calcining, refining, and casting metals, manufacturing glass, porcelain, &c., and generating steam. The advantages of the system are:—

1. A degree of heat, when required, far exceeding that at present attainable.

2. Heat such as can now be obtained only in the centre of large masses of burning fuel, produced and maintained in a much smaller compass, and by the combustion of a much less quantity of coal, &c.

3. Heat exceeding that of the blast furnaces produced without the blast, which is inadmissible in many operations of glass and porcelain manufacture, &c.

4. The absolute command over the intensity and direction of the heat, by regulating the supply and density of the air, opening various entrance and exit valves, &c.

5. The corresponding command over the products of combustion as well as of the operations conducted within the furnaces. The condensed air and accompanying vapours may be passed through water tanks and otherwise treated at pleasure before their ultimate dismissal. By this means all noxious effluvia will be arrested, many products now lost will be rendered valuable, and large districts now barren and almost uninhabitable restored to fertility.

6. The abolition of the enormous chimney stalks and other contrivances for coaxing a sufficient draft of air through the furnaces, which entail so much expense and occupy so much space.

7. The possibility of employing anthracite or other coarse and cheaper qualities of coal, in processes now requiring the high-priced combustible.

8. A large reduction in the size of furnaces for every purpose, effecting a considerable economy in the original outlay, and a permanent saving in the expenditure for repairs.

9. A general saving, on the average, of fully one-third in the consumption of coal, taking the whole process of manufacture.

As an ultimate result, the new system will diminish the size, cost, and consumption of furnaces, will enable the manufacturer to command greater heat in a smaller compass, in a more manageable way, and from a much reduced quantity of cheaper fuel. Analogous effects may be produced in the development of light—and many novel processes introduced in all chemical or manufacturing operations connected with evaporation, distillation, crystallization, sublimation, destructive distillation, &c., &c. New fields are in fact opened of almost unlimited extent and fertility. But into these branches of the subject it is needless to embark at present.

The condensed air chambers will be constructed of sufficient capacity to contain not only the furnaces, &c., but also the moulds, forges, and other apparatus required for the manipulation of their products as well as the workmen so employed. The denser air will not prove injurious to the latter, at all events if not exceeding four atmospheres. In the submarine operations lately conducted rather extensively, the men have found no inconvenience in working for many hours together at 20 fathoms depth, every 5½ fathoms representing an additional atmosphere of pressure.

The original cost of constructing the proposed air-tight chambers, together with the pumping apparatus, will rarely exceed the amount economised in the size of the furnaces, the present blowing machines, and chimney stalks, and the boilers of steam engines.

The power required to maintain a sufficient supply of condensed air will cost little, and sometimes nothing; as the used air emitted at one end of the apparatus will always nearly if not quite suffice, by a simple arrangement, to work the pumps condensing that which is forced in at the other. In many cases indeed, where the escaping air is dismissed at a comparatively high temperature—say 200° F. or more, it will have been so expanded as not only to work the condensing pump, but to leave a considerable margin of extra power available for other work, thus dispensing with the usual steam engine.

I am, &c., A. J. JOYCE.

15, Cambridge-terrace, Hyde-park, W., 5th July, 1862.

Proceedings of Institutions.

Ebbw Vale Literary and Scientific Institution.—The report for the year 1861-62, read at the annual meeting of members, July 1st, says that the previous report was so unfavourable, and in so desponding a tone, that it was with some degree of anxiety the present and retiring committee entered upon their year of office; they feel, however, on a retrospect of the proceedings of the past year, and a view of the present state and future prospects of the Institution, that they can give a much more cheering and hopeful account. The rooms have been remarkably well attended, and the number of subscribers, whose names have been entered upon the books, has risen to 314 (exclusive of honorary members). First quarter, July to October, 210; second quarter, to December, 229; third quarter, to April, 244; fourth quarter, to July, 230. During the past year, an Elemementary Instruction Class, numbering 40 members, has been formed; this class, for the greater convenience of working, has been subdivided under the different heads of "Mechanical Drawing," "Grammar," "Reading, Writing, and Dictation," and "Arithmetic," which meet respectively on Monday, Tuesday, Wednesday, and Thursday evenings. These have been kindly presided over by Messrs. Thomas Morgan, W. J. Gwyther, Thomas Henry, and Charles Newman, to whom the committee are much indebted for their services. It is true that in consequence of the inconveniently small size of the class-room, the meetings of all but the Mechanical Drawing Class have for a time been suspended, but a room more convenient, larger, and well adapted for the purpose is in course of completion, and it is confidently hoped that in a short time the whole of the class will resume its sittings. Since September 1861 there has been formed a Welsh Grammar Class, meeting on every Friday evening. The number of members in this class is 16, and the average nightly attendance 13. In this class the members exercise themselves in reading, translating the best specimens of English prose composition into Welsh, in delivering short essays in that language, and in discussions. Small prizes also have been competed for amongst the members, and altogether the meetings have been very successfully conducted. In order to encourage in some measure these praiseworthy efforts at self-culture, a few of the members of the Committee, assisted by some friends of the Institution, have established on a small scale a Local Prize Scheme, offering prizes for the best Welsh and English compositions on various subjects; at present it may be regarded merely as an experiment. The subject for this year, in both English and Welsh, is, "The advantages to be derived by working men from Literary and Scientific Institutions." Prizes of equal amount will be awarded to the successful essays in both languages:—1st prize, £2 10s.; 2nd prize, £1. The adjudicators are the Rev. C. F. C. Pigott, M.A. of Llanwenarth, and the Rev. Wm. Roberts, of Blaenau. Six English and three Welsh compositions have been sent in. The report of the adjudicators has has not yet been received by the Committee. The Committee add that it is much to be hoped that at no very distant period some of the members will avail themselves of the assistance and advantages which this Institution possesses by being connected with the Society of Arts, and become competitors for the certificates and prizes annually offered by that body. On the unexpected retirement of Mr. Small, who had most efficiently filled the office of Honorary Librarian for four years, the Committee were fortunate enough to secure the services of Mr. Charles Newman, who reports favourably with regard to this department. The issue of books for this year has exceeded that of the last by 504, being the difference between 2,546 and 3,150. The subjoined is an approach towards a classification:—

	English.	Welsh.
History	121	37
Biography	149	10
Voyages and Travels ...	165	13
Art, Science, and Philosophy	195	24
Tales and Novels	1179	11
General Literature	731	100
Religious Literature ...	124	109
Poetry	103	79

The books now number 1,427 volumes, of which 45 have been added this year, viz.:—24 bound periodicals, 12 purchased by the Committee, and 9 presented. During the last year upwards of 60 ancient and modern, foreign and English coins have been presented; 8 specimens illustrative of natural history; 20 geological and mineralogical specimens; together with many curious and interesting objects. The reading room has been exceedingly well frequented. Some few alterations in the papers and periodicals have been made during the past year. The annual *soirée* took place in August, and was most satisfactory; it attracted the attention of about 600 members and friends. The expenses were considerably lessened by the valuable services of several lady and gentleman amateurs, who sang a variety of glees and madrigals; by the gratuitous services of the Ebbw Vale Rifle Volunteer Band; and by the kind assistance of the lady members and friends who presided over the refreshment tables. To these circumstances may be attributed the balance of £8 1s. 11d. in favour of the Lecture and Entertainment Committee. In addition, two entertainments have been given this year:—one entitled, "Shadows on the Wall," by Mr. Basil Young, and the other (musical) by Mr. Owen, of Chester (Owain Alaw), and others. By these the sum of £3 8s. 8d. was realized. By a lecture on "The Philosophy of True Manliness," by Mr. Vincent, a loss of £1 1s. 6d. was sustained. The Treasurer's account shows that the income of the Istitution has been £80 4s. 1d., and that there is a balance in hand of £11 10s. 10d. It is satisfactory to be able to state that, in addition to the above balance, the old debt due to the treasurer at the close of the year has been liquidated.

PARLIAMENTARY REPORTS.

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SESSIONAL PRINTED PAPERS.

Par
Numb.

Delivered on 5th and 7th July, 1862.

338. Alderney—Plan of the Work.
369. Thames Embankment Bill—Copy of Correspondence.
360. Fisheries (Ireland) Bill—Report from Committee.
310. Police (Scotland)—Report of the Inspector of Constabulary.
293. Natal—Copy of Despatches.
363. Military Savings Banks—Account.
364. Coals (Woolwich and Portsmouth)—Return.
367. Judgments (Courts of Common Law)—Return.
368. Hackney Carriage Drivers (Metropolis)—Abstract of Return.
371. Imports from France—Return.
181. Bills—Metropolis Local Management Acts Amendment (amended).
186. ,, Stipendary Magistrates (amended).
187. ,, Merchandise Marks (as amended by the Select Committee, and on Re-commitment).
188. ,, Bleaching and Dyeing Act Amendment.
189. ,, Public Offices Extension.
190. ,, Jamaica Loan (Settlement).

Delivered on 8th July, 1862.

282. Revenue—Return.

Delivered on 9th July, 1862.

319. Steam Vessels—Return.
277. Alice Delin—Return.
378. Railway and Canal Bills—Eleventh Report from Committee.
121. Bills—Highland Roads and Bridges.
192. ,, Savings Banks (Ireland).
194. ,, Divorce Court.
195. ,, Red Sea and India Telegraph Company—Lords Amendments.

French Occupation of Rome—Papers.
Dr. McCarthy's Assassination at Pisa—Papers.

Delivered on 10th July, 1862.

305. Army (Military Stations, &c.)—Return.
375. Education (Ireland)—Annual Report of the Commissioners.
193. Bills—Tramways (as amended by the Select Committee, and on Re-commitment to the same Committee).
196. ,, Gardens in Towns Protection.
197. ,, Courts of the Church of Scotland.
198. ,, Recovery of Poor Rates, &c.

PATENT LAW AMENDMENT ACT.

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APPLICATIONS FOR PATENTS AND PROTECTION ALLOWED.

[*From Gazette, July 18th*, 1862.]

Dated 11th March, 1862.

652. J. Nadal, 14, Brook's Market, Brooke street, Holborn—An improved portable fountain for water or other liquids.

Dated 17th March, 1862.

728. A. S. Stocker and A. R. Stocker, Wolverhampton—Imp. in the manufacture and construction of metal boot heels and tips and horse shoes.

Dated 31st March, 1862.

887. M. A. F. Mennons, 39, Rue de l'Echiquier, Paris—Imp. in the manufacture from vegetable product of glucose or fermentable sugar. (A com.)

Dated 14th April, 1862.

1074. R. A. Brooman, 166, Fleet-street—Imp. in carriages for transporting loads on railways, common roads, and other surfaces. (A com.)

Dated 20th May, 1862.

1520. M. A. F. Mennons, 24, Rue du Mont Thabor, Paris—Improved processes for the conversion of amylaceous matters into saccharine and other useful products. (A com.)

Dated 22nd May, 1862.

1541. J. H. Perry, 72, Piccadilly, St. James's—An improved method of curing diseases of the human body by magnetism.

Dated 29th May, 1862.

1612. P. Boissett and B. Antognini, New York—Imp. in the manufacture of boots and shoes.
1613. P. Boetius, Great George-street—A new mode of cooling (refrigerating) hot liquids, and condensing steam.

Dated 3rd June, 1862.

1669. T. L. Scowen, Allen-road, Stoke Newington—Imp. in indicating time and accent in music.

Dated 5th June, 1862.

1693. J. E. Moiroux, Windmill-street, Tottenham-court-road—A new compound for protecting and preserving the polish, polished and other surfaces of metals, woods, skins, and paper, and for rendering all woven, textile, and other fabrics water and weather proof.

Dated 11th June, 1862.

1734. J. Shand and S. Mason, 245, Blackfriars road—Imp. in the construction of steam boilers.
1738. W. Holland, Adelphi Mills, Salford, Lancashire—Certain imp. in carding engines.

Dated 12th June, 1862.

1751. H. S. Firman and W. J. Williams, 73, Great Suffolk-street, Southwark—Imp. in lamps, more particularly designed for burning paraffine or coal oil and other hydro carbons of different grades, or any combustible material used for obtaining light. (A com.)

Dated 16th June, 1862.

1777. C. E. Courtillier, 184, Boulevart Magenta—Improved inhaling and saturating apparatus.
1779. J. F. Allan, Glasgow—Improved furnace arrangements to prevent smoke and economise fuel.
1781. J. Evans, Hyde, Cheshire—Imp. in self-acting mules.
1783. H. Bright, Woodford, Essex—Improved apparatus or arrangements for screening fires in stoves and grates with the view to avoid accidents.

Dated 17th June, 1862.

1785. S. H. Huntly, 50, Upper Baker-street, Regent's-park—Imp. in the construction of furnaces for effecting the more perfect combustion of the fuel.
1786. A. Crestadoro, 19, Great Ormond-street, Queen-square—Imp. in obtaining and applying motive power from rarefied air and from aeriform fluids.
1787. J. Hunt, Birmingham—An imp. or imps. in bronzing or colouring articles of copper or alloys of copper.
1789. A. W. Makinson—Imp. in locomotive and stationary engines.
1791. A. Pringle, 39, Gloucester-crescent, Camden-town—Certain imp. in locks.
1793. S. Varley, Sleaford, Lincolnshire—Imp. in reaping machines.

Dated 18th June, 1862.

1799. J. Warren, Maldon, Essex—Imp. In ploughs.
1801. W. E. Newton, 66, Chancery-lane—Imp. in electrical brushes. (A com.)

Dated 19th June, 1862.

1803. J. L. Smith, 18, St. John's-square, Clerkenwell—A universal fire alarum with discharging apparatus.

Dated 25th June, 1862.

1865. A. Bayley, Liverpool—Imp. in lamps.

Dated 26th June, 1862.

1875. T. R. Tebbutt, Manchester—Certain imp. in the manufacture of soap, soda, and other material employed for the purpose of washing and cleansing.
1877. J. B. Coquatrix, Rue Folie Mericourt, Paris—Imp. in weaving carpets, tapestry, and similar fabrics, and in apparatus for the same.
1879. J. H. Johnson, 47, Lincoln's-inn-fields—Imp. in the construction of electro voltaic plate work for medical and other purposes. (A com.)
1880. J. H. Johnson, 47, Lincoln's-inn-fields—A new composite fluid to be used for illuminating purposes. (A com.)

Dated 27th June, 1862.

1881. A. Anderson, Islington—Imp. in apparatus for steering ships or other vessels.
1882. J. Watson, 10, Old Bailey—Imp. in printing machines, and apparatus connected therewith for printing from letter-press forms.
1883. C. Cochrane, Middlesbro'-on-Tees—Imp. in the manufacture o aluminate of soda and potash.
1885. C. Cochrane, Middlesbro'-on-Tees—Imp. in the manufacture of iron.
1887. W. Owen, Coventry—The manufacture of woven tickets of silk, cotton, or wool, or mixture of those materials, for the purpose of marking or advertising goods.
1889. A. H. Martin, Buttershaw, near Bradford—Imp. in means or apparatus employed in weaving.
1890. I. Holden, Bradford—Imp. in means or apparatus for preparing and combing wool and other fibrous materials.
1891. A. A. Croll, Coleman-street—Imp. in the treatment of ammoniacal liquor of gas works.
1892. D. L. Banks, 17, Gracechurch-street—A new method of constructing a portable covered coffer dam or apparatus for facilitating operations under the water, in the water, or out of the water, and apparatus connected therewith.
1893. D. L. Banks, 17, Gracechurch-street – A method of constructing a portable sectional dry dock, and apparatus connected therewith.

Dated 28th June, 1862.

1895. T. King, Grafton, and J. King, Chadshunt, Warwickshire—Imp. in agricultural machines.
1896. C. Beslay, Rue Menilmontant, Paris—Imp. in galvanising or coating metals by electro-chemical agency, and in apparatus connected therewith.
1899. G. W. Belding, 7, King-street, Cheapside—An improved flexible spring cloth or fabric especially adapted for the manufacture of ladies' skirts.
1900. C. Callebaut, 4, South-street, Finsbury—Certain imp. in sewing machines.
1901. J. Tatham, Rochdale—Imp. in machinery or apparatus for preparing, spinning, doubling, and winding cotton, wool, and other fibrous materials.
1903. J. Webster, 142, Woodbridge-road, Ipswich—Imp. in the means of protecting steam boilers from incrustation.

Dated 30th June, 1862.

1905. J. Wall and T. Dodd, Liverpool—Imp. in taps for controlling the flow or passage of fluids.
1906. W. Thomas, Liverpool—Imp. in the running gear of four-wheeled carriages.
1907. J. Hartshorn, Mansfield-road, Nottingham—Imp. in the manufacture of lace.
1908. A. Byrnes, 5, Metropolitan-buildings, Mile End New Town—Imp. in breech-loading fire arms.
1909. W. E. Gedge, 11, Wellington-street, Strand—Imp. in looms for weaving. (A com.)
1911. W. E. Newton, 66, Chancery-lane—Improved apparatus for picking or gathering cotton. (A com.)
1913. T. Parker, Woodhouse Carrs, Leeds—Imp. in tinting or dyeing fabrics composed of mixed animal and vegetable fibres.

Dated 1st July, 1862.

1917. R. A. Brooman, 166, Fleet-street—Imp. in the construction of blast furnaces. (A com.)
1919. G. H. Birkbeck, 34, Southampton-buildings, Chancery-lane—Imp. in processes for the utilisation of certain refuse products resulting from the manufacture of iron, such processes being applicable to the treatment of other metallic or mineral substances. (A com.)
1920. J. Greenhalgh, Hyde, and J. Greenhalgh, Audenshaw—An improved diminishing valve, and also a water or steam escape apparatus to give alarm in case of fire, and to assist in quenching the same.
1921. T. Fellowes and H. Hemfrey, Spalding—Imp. in apparatus for elevating straw and other agricultural produce.
1923. W. E. Newton, 66, Chancery-lane—Improved machinery for washing wool. (A com.)

Dated 2nd July, 1862.

1924. E. de Labastida, 43, Hart-street, Bloomsbury-square—A new method of manufacturing india-rubber articles, by the simultaneous combination of pressure and vulcanisation. (A com.)
1925. W. Porter, Fleetwood—Imp. in the manufacture of targets.
1927. J. Ellerbeck, Heywood, Lancashire—Imp. in looms for weaving.
1929. T. L. Atkinson, Stamford-street, Blackfriars-road—Imp. in the construction of stew pans and other such like cooking utensils.
1930. G. H. Hulskamp, 53, Chancery-lane—Imp. in violins and other similar stringed instruments, and in guitars.
1931. J. Murray, Whitehall-place—Imp. in portmanteaus.
1933. J. Crisp and J. W. Elliott, East King-street, South Shields—Imp. in apparatus for burning American rock oil, paraffine oil, oil of petroleum, and other inflammable oils, spirits, or essences.
1935. G. Bedson, Manchester—Imp. in rolling wire and other rods or bars of metal.

Dated 3rd July, 1862.

1941. T. Edmunds, Seymour-place, Bryanstone-square—Imp. in preparing compressed fruits in cakes.
1943. J. Miles, Street, near Glastonbury, Somersetshire—Imp. in machinery for cutting out soles and other parts used in the manufacture of boots and shoes, and also parts used in the manufacture of other articles.

Dated 4th July, 1862.

1944. S. Russell, 27, Shaftesbury-crescent, Pimlico—Imp. in stereoscopes.
1945. W. J. Cunningham, Everett-terrace, Victoria Dock-road—Imp. in sewing machines.
1946. A. Drevelle, Manchester—Imp. in machinery or apparatus for laying cards or sheets of metal into woven or textile fabrics ready for the press, and also for folding, measuring, or stretching the said fabrics, paper, and other materials.
1947. S. Whitham, Wakefield—Imp. in the manufacture of iron and steel, and in the apparatus employed for that purpose. (A com.)

Dated 5th July, 1862.

1949. H. Rushton, 48A, Northampton-road, Clerkenwell—Imp. in covering crinoline steels.
1950. R. A. Brooman, 166, Fleet-street—Imp. in hollow plates for hydraulic presses. (A com.)
1951. Capt. O. F. Bystrom, Stockholm, Sweden—An improved pyrometer.
1952. C. G. Hill and W. Jackson, Commerce-square, High Pavement, Nottingham—Imp. in machinery or apparatus for producing ornamental patterns or figures and attaching them to lace or other fabrics.
1953. A. Warner, 31, Threadneedle-street—Imp. in preparing materials for and in purifying coal gas.

Dated 7th July, 1862.

1957. T. Edwards, Liverpool—Improved movement for the indices for gas, water, and other fluid meters.
1959. J. P. Booth, Cork—Imp. in the manufacture of feather beds, quilts, bolsters, and pillows.

Dated 8th July, 1862.

1960. W. Spence, 50, Chancery-lane—Imp. in telegraphic apparatus. (A com.)
1962. C. B. Gruner, 25, Alfred-street, River-terrace, Islington—Imp. in photographic apparatus.
1968. J. Bourke, Her Majesty's 29th Regiment of Foot, Curraghleagh, Clanmorris, Ireland—Imp. in military accoutrements.

Dated 9th July, 1862.

1972. T. C. Gibson, Ramsey, Isle of Man—Imp. in the construction of ships and vessels for the purpose of carrying and warehousing petroleum, palm oil, and other oils or inflammable fluids.
1974. H. S. Pontifex, Banbury—Imp. in apparatus for distributing water applicable to cleansing casks or other vessels, or for other purposes.
1976. C. F. W. Rust, London Wall—Imp. in concertinas and other wind instruments of that class. (A com.)
1980. T. Green, Leeds, and R. Mathers, 2, Victoria-street—Imp. in steam boilers.
1982. J. O. Butler, Kirkstall Forge Company, near Leeds—Imp. in steam hammers and in framings therefor.

Inventions with Complete Specifications Filed.

1971. J. M. Gille, 24, Rue du Mont Thabor, Paris—An improved calendar inkstand.—9th July, 1862.
1990. E. Townsend, Massachusetts—A new and useful invention for making nails, and driving such nails into the sole of a boot or shoe. (A com.)—10th July, 1862.
2006. M. A. F. Mennons, 24, Rue du Mont Thabor, Paris—Certain imp. in vessels mounted as floating batteries. (A com.)—12th July, 1862.

Patents Sealed.

[*From Gazette, July 18th*, 1862.]

July 18th.

158. A. J. Martin.
159. R. A. Brooman.
160. W. Burgess.
165. F. W. Gerish.
166. E. Pace.
178. A. Ripley.
184. W. Clark.
185. J. Longhurst.
195. J. C. F. Mougin.
235. W. Clark.
246. E. A. Rippingille.
250. W. Clark.
259. W. Walton and F. Walton.
276. T. Cook.
279. W. Clark.
283. D. Joy.
291. C. M. Roullier.
316. M. Henry.
338. M. A. F. Mennons.
650. H. H. Kromschweder.
759. F. Warner.
1003. J. Lawson.
1012. W. Davies.
1015. C. Mather.
1113. J. W. Ford.

[*From Gazette, July 22nd*, 1862.]

July 22nd.

188. T. Morris, R. Weare, and E. H. C. Monckton.
189. C. G. Hall.
194. C. West.
197. D. Eldeston & H. Gledhill.
198. E. A. Curley.
200. F. J. L. Lefort.
202. J. Brown and J. Davenport.
207. R. Martindale.
208. C. W. Harrison.
214. H. H. Treppass.
222. S. C. Lister & J. Warburton.
238. B. Foster and J. Moore.
242. M. Collier.
244. M. Allen.
245. T. Gontard.
247. J. Firth.
252. A. Lahousse.
253. D. Littlehales.
896. R. Burley.
922. W. C. Harrison and H. J. Standly.

Patents on which the Stamp Duty of £50 has been Paid.

[*From Gazette, July 22nd*, 1862.]

July 16th.

1684. H. Cunew.
1724. J. Broadley.

July 19th.

1738. J. Gillott and J. Morrison.

Patents on which the Stamp Duty of £100 has been Paid.

[*From Gazette, July 22nd*, 1862.]

July 16th.

1633. J. H. Johnson.

July 18th.

1629. D. Fisken & T. R. H. Fisken.
1640. H. D. P. Cunningham.

LIST OF DESIGNS FOR ARTICLES OF UTILITY REGISTERED.

No. in the Register.	Date of Registration.	Title.	Name.	Address.
4494	July 12	Fastening for Porte-monnaies and other cases	Christian Weinhand, jun. ...	Offenbach-on-the-Maine.
4495	„ 17	The Concavoterminal Cigar	Henry Binnell Harris	Birkenhead.
4496	„ 19	The Lever-hinged Bag Frame	William Orth and Company.	15, Chiswell-street, E.C.
4497	„ „	Improved Steam Trap	William Oxley and Company.	Manchester.
4498	„ 22	Sugar Tongs and Cutter...	Joseph Orchard	Birmingham.